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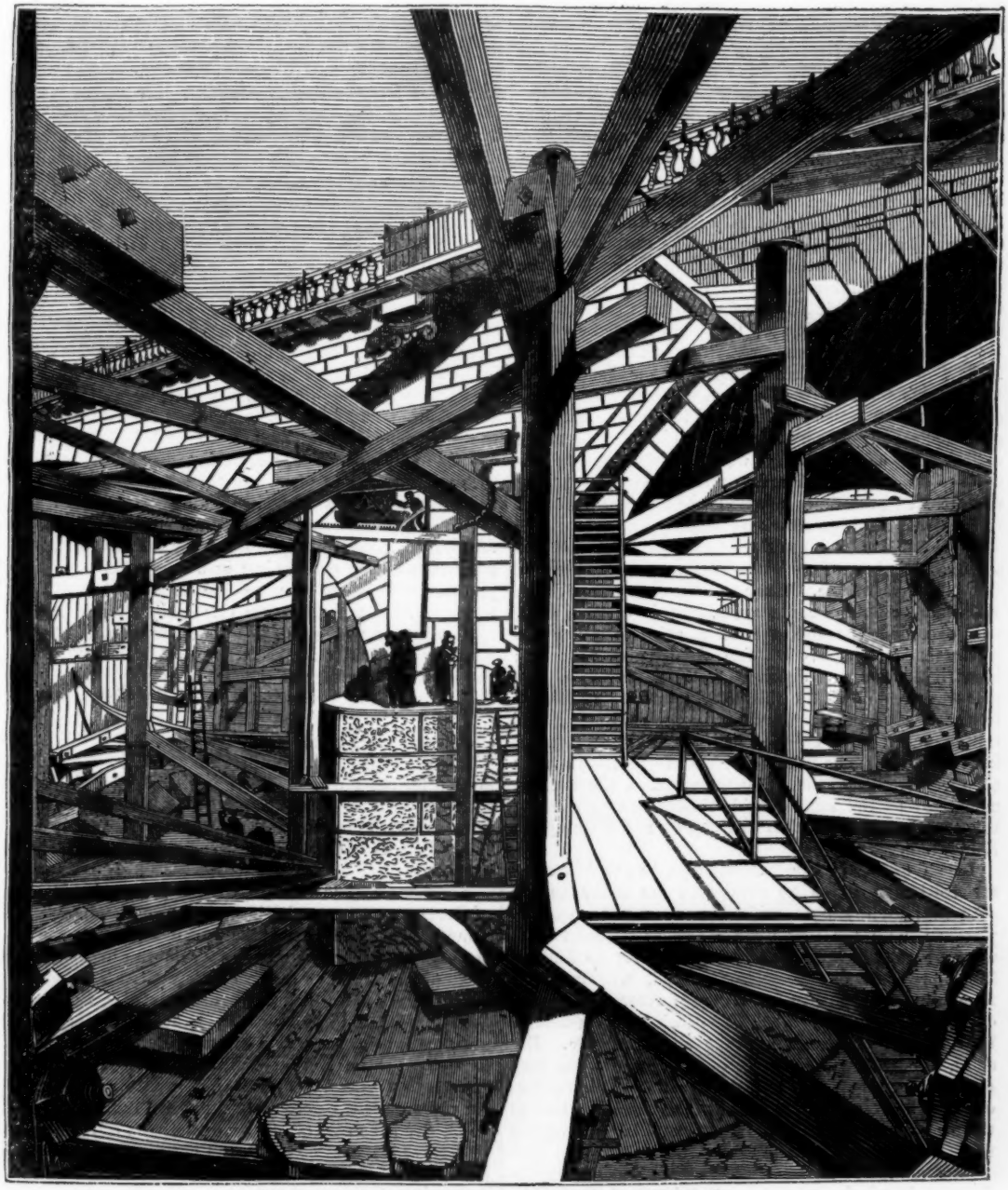
COFFER-DAM.



[Coffer-dam for carrying on the repair of Blackfriars' Bridge.]

IN bridge-building, as in most other useful arts, improvements have been effected, within a comparatively recent period, which afford striking proofs of the progress of scientific knowledge. Westminster Bridge was completed in eleven years, having been commenced in 1739 and opened in 1750. Blackfriars' Bridge was finished in 1760, ten years after it had been commenced. The New London Bridge, combining, in a higher degree than any other similar structure in the world, grandeur and simplicity, with utility as an

immense commercial thoroughfare, was completed in seven years five months and thirteen days; being about one-third less time than was required for the erection of Westminster Bridge. Waterloo Bridge was erected within a shorter period, but the obstacles were less formidable than in the other cases.

When it is considered that these bridges are thrown over a deep, wide, and rapid river, and that the tide rushes beneath their arches with great force, they cannot but be regarded as among the highest triumphs of man over physical difficulties. Of the present bridges, that of 1739 was the longest in erecting: Old London Bridge was forty-four years from the time of being commenced to its completion. The shorter time now required in the construction of bridges is owing to the improved state of the art, and to the energy and activity of a generation more deeply sensible of the importance of such works in promoting profitable intercourse, and aiding the operations of a widely-extended commerce.

Before Westminster Bridge was opened, a portion of the structure gave way, and the completion of the bridge was delayed a year and a half in consequence. Since then, it has so repeatedly failed, that nearly all the piers have had to be rebuilt. The causes to which this failure may be attributed are now obviated by the adoption of a different process from that which was formerly in use;—viz., by the formation of coffer-dams, in which the foundation of the piers is securely laid, instead of the old system of resorting to caissons, which is now generally decried, though, when Westminster Bridge was built by M. Labelye, a skilful French engineer, it was much praised for its ingenuity. We shall endeavour to make both plans intelligible to the reader. In ancient times, we may remark, the laborious expedient of directing a river into a temporary channel was sometimes adopted when it was intended to construct a bridge across its waters.

A caisson was a large floating vessel, formed of the strongest timber, of the size and form of the piers of the intended bridge. Each of the caissons of the Westminster Bridge contained 150 loads of fir timber, and exceeded the tonnage of a ship of 40 guns. Their size was nearly 80 feet from point to point; breadth 30 feet, and depth 10 feet. A portion of the pier was erected within this vessel; and being floated to the site of the proposed bridge, the water was admitted, and it sunk, the pier being guided to its proper bed by ropes. The sides and ends of the caisson were then removed, and floated to the surface; the bottom, composed of the most durable timber, strongly bound together, remaining under the stones, and forming the foundation.

In an article in the 'Companion to the Almanac' for 1831, the following objections are made to the plan of founding a pier with caissons:—"The wooden platform, with the pier upon it, being dropped as it were by chance into the stream, is likely to find an irregular or a flat foundation; and, whenever the foundation happens to be of the former description, currents and springs are sure to insinuate themselves beneath, and unsettle the whole superstructure. Besides, wooden foundations are only safe as long as they can be kept completely immersed in water; so that, as often as a very low ebb takes place, there is a risk of the air gaining access to the timber and implanting the seeds of speedy dissolution."

The method of founding piers now in use is by coffer-dams, a description of which we take from the writer just quoted:—"A coffer-dam," he says, "is a space in a river enclosed by two or three rows of piles, generally of either oak, elm, or beech, driven into the ground close together by means of a steam-engine, or any other adequate power. The water then is pumped out from the enclosed space, in order that the foundations of the intended pier may be laid in the solid ground. There are two sorts of piling in common use—one known by the name of close piling, the other called grooved and plank piling. Close piling is executed in the following manner:—The piles having been driven into the ground close together, are made fast at the top by bolting to them longitudinally two strong pieces of timber, technically termed wailing pieces, one on each side; bolts, however, are only driven through every fourth or fifth pile. In grooved, or planked piling, the piles are grooved across, and planks of timber introduced into the grooves. This method gives great neatness to the dam, and generally supersedes the necessity of puddling with clay. It is not, however, remarkable for security. In both cases the lower ends of the piles are sharpened or cut in a pyramidal form, and shod with iron; and the upper extremities are encompassed with a ring of the same metal, to prevent their splitting by the force of the iron ram by which they are driven into the earth. The mode followed in the construction of the coffer-dams at the new London Bridge differed somewhat from both of those just described. In consequence of the bed of the river at the site of the bridge being upwards of thirty feet in depth at low water of spring tides, and the current being at all times extremely rapid, it was found necessary to have recourse to several additional expedients to give the coffer-dams sufficient strength to keep out the water. The general form of the dam was elliptical. Three rows of piles, dressed in the joints and shod with iron, many of them measuring from eighty to ninety feet, were driven into the ground; and after being firmly bolted together in the way before described, were puddled with clay. Wooden stays, or props, were then introduced between the different rows of piers, and the whole of the interior space strongly truss-framed in a diagonal manner; and the longitudinal beams were firmly strapped together, forming at their joints abutments for the braces. Stairs were formed for descending into the coffer-dam, and pumps were fixed to raise the water arising from springs or leakage. Within this enclosure the pier of solid masonry was erected." The lowermost course of masonry was laid on piles of beech driven in the interior of the coffer-dam to a depth of nearly twenty feet. Notwithstanding the resistance of the water to this coffer-dam it was generally dry, and the steam-engine and pumps were rarely used.

The cut represents the operations within a coffer-dam formed for the purpose of carrying on the repair of the decayed parts of Blackfriars Bridge. The workman pursues his labours with as much comfort in this coffer-dam as under any open shed erected on dry ground.

London Bridge is built of granite, Waterloo Bridge of Cornish granite, and Blackfriars Bridge of Portland stone, a material which becomes soft and friable when exposed for a great number of years to a moist atmospere or the alternate action of air and water. Hence the bridge gradually became dilapidated. Engineers were employed to examine it, and having made an unfavourable report as to its state, it was determined to apply for an Act of Parliament for authority to undertake the repair of this important thoroughfare. An estimate laid before the Common Council in April, 1833, fixed the cost of repairing that part of the bridge above low water at 60,000*l.*, and of piling, coffer-dams, and securing the foundation at 30,000*l.* The restoration of the decayed parts of the bridge have now been going on above two years. It is intended to case the piers with piles covered with masonry. The quantity of timber required for the fifth pier is 30,000 cubic feet, and each pier will require a casing of 10,000 cubic feet of granite. In the course of making these improvements and repairs, four coffer-dams will require

to be formed. It is intended to remove the present balustrade, and to substitute a plain parapet, somewhat similar to that of London Bridge. The approaches to the bridge will be made less steep both on the Surrey and city side. This is an alteration which has long been greatly needed, as every one will be aware who has been in the habit of crossing the bridge and witnessed the frequent obstructions which occur in ascending or descending the extremities.

ENGLISH COINS.

The word coin (Latin *moneta*, *nummus*, German *munze*, *Geld*) is supposed by Sir Edward Coke (Coke on Litt.) to be derived from the Greek word κοινος, that is *communis*, because it is commonly made use of in all affairs; it is a piece of metal impressed in various ways for circulation by order of a prince or state, and it is requisite that the pieces coined should be of the same weight and fineness, and that a certain denomination should be given by authority to each species of coin.

The figure of English money is always round, except the Newark shilling of Charles I. and some few other coins. When Cæsar invaded Britain, he said of the natives "they make use of brass instead of golden coin, or iron rings reduced to a certain weight instead of coins;" and Speed avers that he himself had seen little earthen cruses or pitchers dug out of the ground which contained rings of iron and plates of brass assized at a certain weight. Rude coins of copper, mixed with tin, are frequently found in this country: they are of the size of a didrachm, the usual form among the ancients of the *nummus aureus*.

There are undoubtedly British coins prior to Julius Cæsar, but they cannot be, with any degree of certainty, ascribed to individual monarchs. The British coins are known by their particular forms, being commonly embossed outward and shield-like, on which the inscription is seen with a hollow reverse, within which is set their device, a form used by no other nation except among some of the Grecians: the most ancient of the British coins are impressed on one side only, and have a device without any legend. Those which have an obverse and reverse are also without legend, except SEGO [nax] and CUNOBELIN. The earliest coin (according to Fosbroke) which can, with any probability, be attributed to any particular British monarch, has on it the letters SEGO, probably for Segonax, one of the four Kentish kings, who by command of Cassevelin attacked Cæsar's camp upon his second arrival in Britain. There are many coins of Cunobelin (the British Museum having a fine collection formerly belonging to Sir Robert Cotton), who was king of the Trinobantes: it is said that he was educated in the court of Augustus and was tributary to the Romans: he resided at Camulodunum, which is supposed to be now Malden in Essex; and according to some authors, he was commander of the Britons in their wars against Cæsar. These coins of Cunobelin are only probably British, for the portraits, sizes, and seeming age, vary so much, that it is conjectured that they cannot all belong to this Cunobelin, though the types are evidently Roman. Most of those yet discovered have CUNO upon one side with an ear of wheat, a horse, a kind of head of Janus, or some such type, and often CAMO, supposed to be Camulodunum, upon the other side, with a boar or tree or other symbol. (Fig. 1*) is a coin of Cunobelin, which bears on the reverse TASCIA, a word of which various explanations are given by antiquaries, but none in any degree certain. The coins of Cunobelin are most frequently formed of copper, but some are of gold, silver, and electrum (which is gold, with a fifth part or more of silver).

Fig. 1.

[Silver of Cunobelin.]

* The coins are all represented of the exact size.

The Britons were so entirely subdued under Claudius, that the Roman imperial edict ordaining all money current among them to bear the imperial stamp, was strictly enforced, and no British money appears afterwards. Ruding says that no *Roman* coin bearing the name of a British town has yet been discovered, though it is by some asserted that Constantine the Great had a mint in London, and Camden states that he had seen copper coin of that date with this inscription, P. London. S. (*Pecunia Londini Signata*). On the earliest of the Roman imperial coins, Britain is represented by a female figure sitting on a globe with the *labarum*, the symbol of military power, in her hand, and the ocean rolling at her feet. Figures 2 and 3 represent the

Fig. 2.

[Reverse of Antoninus Pius. Brass.]

Fig. 3.

[Reverse of Antoninus Pius. Brass.]

reverses of two coins of Antoninus Pius, which with slight variations are the type of the present copper coinage. As many as twenty Roman coins have been struck at various times relating to Britain, while those personifying Italy, Gaul, Spain, and other regions of the empire do not exceed four or six at the most for each country. The circulation of Roman coin continued in this country, according to some antiquaries, 300 years, according to others, 500 years, but it is now generally admitted that the Romans finally left Britain in the reign of the Emperor Honorius.

The silver skeatta or penny (figs. 4 and 8) a coin of

Fig. 4.

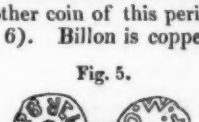
[A silver skeatta.]

Fig. 8.

[Silver skeatta of Egbert, King of Kent.]

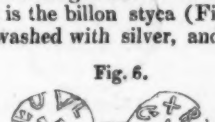
the Heptarchy, appears as early as the sixth century: it was probably brought from the continent by the Anglo-Saxons. Most of the skeattas, as is denoted by their symbols of serpents and other rude figures, were struck in the time of Paganism; but some of the later ones have legends. The precise value of the skeatta is unknown, but they were coined in Kent and the early Heptarchic states, from the sixth to the eighth century. Fig. 8 is a skeatta of Egbert, king of Kent, A.D. 664, who was renowned for his encouragement of learning. Another coin of this period is the billon styca (Figs. 5 and 6). Billon is copper washed with silver, and the

Fig. 5.



[Copper Styca of Redwulf, King of Northumbria.]

Fig. 6.

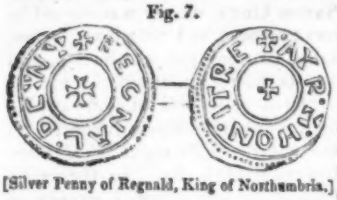


[Copper Styca of Osbrecht, King of Northumbria.]

styca is supposed to have been equal in value to about half a farthing. They are only known of the later period of the kingdom of Northumbria, or of the Archbishops of York: they are the Minuta of Domesday

Book, whence the modern word mite. The exact time of the introduction of the silver penny, properly so called, is unknown; the Heptarchic pennies are almost all of the eighth century. The first of them is that of Ethelbert II., between the years 749—760. Besides these, there was the Half-ling, or Half-penny, of silver, as was probably the Feorth-ling, or Feoрðvng, the fourth part, or farthing. All these coins, except the farthing, are found, and it is conjectured that there was the Triens, which divided the penny into three equal parts.

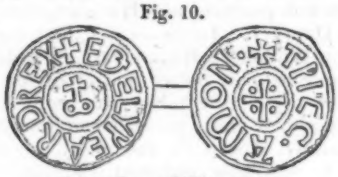
Fig. 7.



[Silver Penny of Regnald, King of Northumbria.]

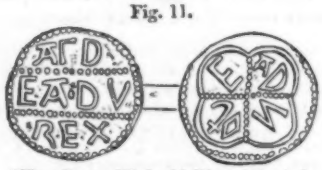
There are many Heptarchic pennies found; for specimens of some of them see Figs. 7, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19. Fig. 10 is a coin of Æthelweard, who is said by some to have been king of the West Saxons, while others suppose that he was an unknown king among the East Angles: 249 of his coins were found at Dorking in Surrey in 1817. On a coin (Fig. 19) of Ciolvolf is the place of mintage, Dorobernia, or Canterbury; the ancient historians are so confused and contradictory, that it is impossible accurately to fix the exact order of the date of the Heptarchic pennies; their resemblance to each other in rudeness of execution is in general considerable, and their uncouth portraits scarcely afford the semblance of a human countenance. In the series of Anglo-Saxon coins, none are equal in interest to those of Offa, king of Mercia, a prince so considerable, that he enjoyed the friendship and alliance of Charlemagne. His coins are executed in a style of drawing without parallel in the money of this country, from the time of Cunobelin to the reign of Henry VII. The types of the reverses are extremely numerous. Fig. 12 is a penny of Offa, bearing a Runic legend, which is supposed to signify the name of Botred, who was a moneyer or officer of the mint of the Heptarchic period. It is remarkable that we find the workmanship of the coins of Coenvvlf (Fig. 13), the successor of Offa, much deteriorated. The Mancus, the Mark, the Ora, the Shilling, and the Thrimsa, are supposed to have been only money of account, and not actual coins; but a mancus, according to Hume, on the authority of Spelman, was about the weight of our present half-crown, and three hundred mancuses were granted by Ethelwulf, father of Alfred, to the Pope; one-third to support the lamps of St. Peter's; another those of St. Paul's; and a third to the Pope himself. If the mancus was ever current, it was probably of foreign mintage. The mark was two-thirds of the money pound in value, and in 1309 the pensions allowed by the king to the cardinals and great officers of the Pope, who were, as it were, retained by the court of England, were to some a hundred, but to most of them fifty marks per annum. It is conjectured that ora signifies *uncia*, but Spelman says that ora was also a piece of money valued at sixteenpence, for which he cites this passage: "Plac. coram Rege T. Mich. 37 H. 3. Rot. 4. The men of Berkeholt Com. Suffolc. say that in the time of king Henry, the grandfather of our present lord the king, they had a custom that when they would marry out their daughters, they were wont to pay for leave so to do two oræ, which are valued at thirty-two pence." It is asserted that the thrimsa was fourpence of Saxon money. Besides the ecclesiastical

Fig. 10.



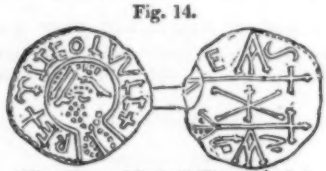
[Silver Penny of Æthelweard.]

Fig. 11.



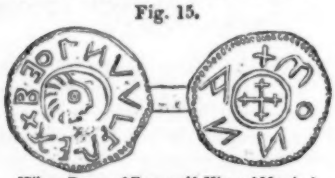
[Silver Penny of Eadwald, King of Mercia.]

Fig. 14.



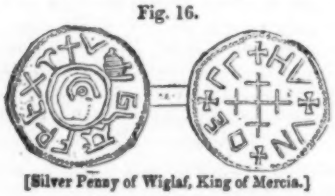
[Silver Penny of Ceolvvlf, King of Mercia.]

Fig. 15.



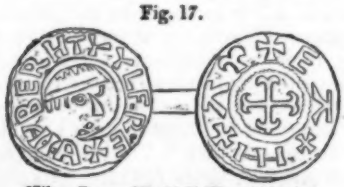
[Silver Penny of Beornvvlf, King of Mercia.]

Fig. 16.



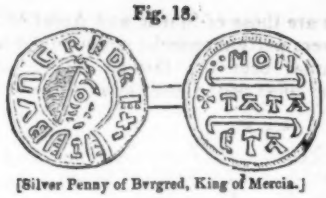
[Silver Penny of Wiglaf, King of Mercia.]

Fig. 17.



[Silver Penny of Berhtulf, King of Mercia.]

Fig. 18.



[Silver Penny of Bvrgred, King of Mercia.]

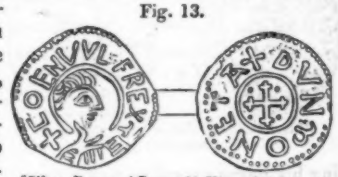
Fig. 19.

[Silver Penny of Ciolvvlf, King of Mercia.]

Fig. 12.

[Silver Penny of Offa, King of Mercia.]

Fig. 13.



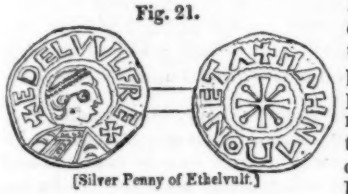
[Silver Penny of Coenvvlf, King of Mercia.]

coins, there are those of Sihtric and Anlaf of Northumbria, who were petty monarchs not subdued by Egbert: those of Anlaf bear the Danish ensign, the famous raven. The coins of the chief monarchs display almost an entire series from Egbert (Fig. 20), A. D. 832. There being none of Ethelbald, and Edmund Ironside breaks the series. Fig. 21 is a penny of Ethelwulf or Ethelvulf, father of Alfred. Most of the coins of this period have rude portraits, and the reverses are sometimes interesting: one of Edward the Elder has the cathedral of York, with three rows of windows round, arched. The inscriptions are occasionally curious, as on Egbert's coins, SAXONVM for Anglorum, and on Ethelwulf, SAXONIORVM. Pennies of Athelstan bear REX TOT. BRIT., or Totius Britanniæ, probably struck after his defeating Constantine King of Scotland. Fillets of pearls and crescents distinguish the Anglo-Saxon kings of the Heptarchy; and rude kinds of crowns, with rays and pearls, are mixed with fillets among the sole monarchs. The sceptre first appears on coins of Ethelred II. (See Pl. 22 of Ruding's Saxon Series.) The reverses of the royal Anglo-Saxon coins are nearly all names of moneyers and mints, but monograms occasionally appear; and on several coins of Ethelred II. (see Ruding's Pl. 22.) is the hand of Providence, with the letters A and Ω, supposed to be the only instance in which Greek characters occur on any coins of the Anglo-Saxon monarch. Fig. 9 is a penny of Ceolnoth, Archbishop of Canterbury, as a specimen of one of the many ecclesiastic coins of this time. The moneyer, or officer of the mints, putting his name on coins, was a practice unknown till the sixth century. It was introduced, by degrees, a century after the Roman mints had ceased with that empire in Europe, and when private persons contracted with the monarchs for the small mints, and put their names to identify their mintage. Till Athelstan, there are only names of moneyers, except on a few coins of his predecessors, Alfred and Edward the Elder, where we find the towns added, a practice general after the time of Edward the Martyr. The use of the hammer in fabricating money was of very easy management, and attended with very little expense—hence the number of moneyers whose names appear on the early coins. A remarkable circumstance attending hammered money is the tenuity and large size in respect of the value, in consequence of which no relief could be easily given to the impressions. Coins of genuine antiquity are sometimes found split on the edges, or even in the centre, from the force of the hammer. Three or four hundred moneyers were employed at a time in the Anglo-Saxon mints, and they occasionally travelled about with the kings to coin money on emergencies. There are instances where the names of two moneyers occur on the same coin. The last example of the appearance of a moneyer's name is in the reign of Edward I. Under the Saxon kings, money was coined in London in eight different places; at Canterbury, seven, four being for the king, two for the archbishop, and one for the abbot; at Rochester, in three places; at Winchester, six, &c. In a close roll of Edward I., there is an account of a mint with thirty furnaces, in the Tower of London; another with eight, at Canterbury; four at Kingston-upon-Hull, &c. In the reign of Queen Elizabeth, no mint was allowed, except in the Tower of London, which practice was continued, till the civil wars compelled Charles I. to coin money at Oxford, York, Aberystwith, Exeter, Newark, Pontefract, and other places. His necessities obliged him to establish numerous mints. Money was afterwards again ordinarily coined at the Tower till the erection of the present Mint within these few years. The cross, the use of which on coins is said to owe its origin to Constantine the Great, appears frequently on Saxon coins, and in the Norman reigns it is asserted to have been so deeply impressed, that the coins might be divided into halves for halfpence, and quarters for farthings: which practice, says Hoveden, continued till the time of Henry I. Leake denies this; but there is a passage in Whitaker's Richmondshire, which shows that coins were actually halved and quartered for currency. Stow says, "the penny was wont to have a double cross with a crest, in such sort that the same might be easily broken in the midst, or into four quarters. It was now ordained (Edward I.) that pence, halfpence, and farthings should be made round, whereupon were made these verses following:—

Fig. 20.

[Silver Penny of Egbeorht.]

Fig. 21.



[Silver Penny of Ethelvulf.]

Fig. 9.

[Silver Penny of Ceolnoth, Archbishop of Canterbury.]

"Edward did smite round penny, halfpenny, farthing;
The crosse passes the bond of all, throughout the ring:
The king's side, was his name written;
The crosse side, what city it was incoyned and smitten.
To poor man, ne to priest, the penny frayes nothing,
Men give God ay the least: they feast him with a farthing.
A thousand, two hundred, fourscore years and mo,
On this money men wondred, when it first began to goe."

Scarcely a find of Saxon, and more particularly Norman coins occurs, in which halves and quarters of the penny are not found, cut with the greatest exactness.

[To be continued.]

THE HEMLOCK OR CROMLECH STONE NEAR NOTTINGHAM.

IN descending the hill from Risby toll-gate towards Sandyam, on the road from Derby to Nottingham, the observant traveller will be struck with the singular appearance of the prospect before him, and he will not fail to remark that, in its general features, particularly in the distant parts towards the left hand, it very much resembles some of those scenes we have seen pictured by our missionaries abroad. A high ridge of land covered with firs and larches, and other trees of loose ramification, just cutting the horizon with their slight open foliage,—a deep shady wood on another ridge,—and, between them, an apparently barren knoll, bearing on its summit a singularly-shaped rock,—give to the whole an appearance completely foreign; and the unshaped pile becomes a resemblance of one of those monstrous idols still worshipped by barbarians.

This fragment of rock lies at the distance of about three miles from the point where it is first observed, and may be visited by turning through the toll-gate at Whanscote House and proceeding about three-quarters of a mile along the road, when it bursts suddenly on the sight, on a high bare hill to the right hand, and but at a few hundred yards' distance. Its appearance

now is singularly imposing; and the observer feels satisfied that it is a monument of antiquity, and that it must, at some period, have been the scene or the object of religious veneration.

In the neighbourhood, this remarkable fragment is known by the name of the "Hemlock Stone." It, I have no doubt, was originally called the "Cromlech," or "Crumlech Stone,"—a name which at once points out its original use. The provincial pronunciation of *hemlock* is *humlock*: the transition from *crumleck* to *humlock* is natural and easy; but, as if to divest it of vulgarity, and confine to the plant its distinct appellation, it is now universally called, as before mentioned, the "Hemlock Stone."

This stone lies about five miles from Nottingham; and the ridge on which it stands is of the same conformation as the rock on which Nottingham Castle is built,—as that in which the various caves are scooped in the park, and, in fact, similar to the ground on which the town itself is situated. It is a huge piece of a reddish rock, of perhaps fifty feet high, presenting on one side a broad flattish face, and at each end an appearance not much dissimilar to the Cheese-wring of Cornwall. It is full of seams and crannies, but yet appears to be one connected, if not entirely compact, stone. The top projects over the sides and ends very considerably, and has a gentle slope of its plane summit towards the east. This, if it does not prove it to have been a cromlech, shows at least its possessing one of its most distinguishing properties. It is evidently a work of Nature; and in its present state, independently of whatever may have been the use to which it has been put to, is an object not devoid of picturesque beauty.

It appears highly probable that it has been a druidical altar; for it stands on the sloping side of a hill, commanding an extensive view of a plain in which thousands might assemble, and was overlooked by two other hills of something greater altitude, not unlikely at the time, covered with a wood of native oaks; and it was within a little distance of the druidical residence in Nottingham Park: besides, as there was not a place of sacrifice nearer than those on the Peak Hills, in the neighbouring county of Derby, such a place would of necessity be wanting. It seems therefore natural to conclude that it has been used for such a purpose.

It is singular that none of our tourists and few of our topographers have so much as mentioned this cromlech-stone: perhaps its lying at a little distance from the road, and not being in sight, except at three or four miles' distance, may have been one reason; yet I feel convinced that, had such a monument stood on the summit of one of the hills of Wales, or Cornwall, or Devonshire, it would long ago have attracted the notice of our travelling antiquaries.

The stone itself is entirely void of verdure, except having on the top a small straggling sloe-bush, and, a little below, a few small tufts of polypodium. It is not much enriched with lichens and weather-tints; but from its dark enormous mass projecting against the light horizontal sky, and the well-wooded distance contrasting with the flowers of the luxuriant furze-bushes in the fore-ground, it forms a picture to which its singularity adds an interest.

THE LABYRINTH OF CRETE.

IN a recent article, while treating of Grecian dresses and dances, we had occasion to allude to this extraordinary excavation, which was once classed among the wonders of the world, and was supposed to be of the remotest antiquity. A short description of the labyrinth, or at least of the excavation which is generally supposed to be the ancient and famed work (for there are some doubts on the subject), may amuse our readers, and give them an excellent field for conjecture as to the uses and object of a work of such labour and extent.

In the island of Crete, which is now called Candia, upon the side of a mountain forming one of the roots of Mount Ida, and at the distance of four miles from the town of Agiosdeka (the ancient Gortyna), there is an opening somewhat in the shape of a mouth, of a man's height, and no way distinguishable from many apertures in the neighbourhood. But this common-looking entrance leads to passages beautifully cut out in the rock, which twist and turn, diverge from, and intersect each other in so puzzling a manner, that, without a clue, or great precaution, it seems almost impossible for a person once engaged in them to find his way out again. Nearly the whole of the mountain is cut through and through by these subterranean mazes, which, from their irregularity, appear rather as the effect of chance than the designed work of man. When the old French traveller Tournefort visited the place, every one of the party carried a torch: at every difficult turn they stuck up, on the right-hand side, pieces of paper marked with numbers; one of the guides lighted faggots made of the branches of the pine-tree, and left them to burn at certain distances from each other, and another guide scattered pieces of straw on the ground as they went along. And yet, with all these precautions, it should appear that Tournefort was able to explore only a part of the labyrinth. A more recent traveller (the Honourable F. S. North Douglas) undertook the task with a great many guides, furnished with torches and lanterns, and 1300 yards of packthread; but he too was obliged to leave many of the windings unexamined, and to abstain from entering some high and broad passages that seemed calculated to entice and then bewilder him.

Immediately beyond the entrance to these caves there is a small chamber, to the right of which there runs a passage which is 3300 feet long, and on an average 12 feet wide and 10 feet high, though Tournefort says that in some places he was obliged to stoop a little, and that at one point, about the middle of the road, they found the passage so low and so narrow, that they were obliged to crawl on their hands and knees, one by one. This passage neither ascends nor descends very much; the floor is smooth and level from side to side; the walls or sides are perfectly perpendicular, and formed of the solid rock, except here and there, where they are cased with masonry most carefully executed. At every ten or twelve paces new passages of the same sort present themselves, and they, in their turn, either break off into other passages, or return to the original passage from which they had diverged. After an apparent progression in this subterranean puzzle of nearly an hour, Mr. North Douglas's party, who thought themselves in the very heart of the mountain, came back upon their packthread at the very place whence they had started. This gentleman remarked as a striking peculiarity, that, instead of finding any close or unwholesome air in these narrow recesses, they breathed as freely when they were nearly a mile from its mouth as when they first entered the labyrinth. He also observed that all the angles in this singular excavation were as sharp as if they had just been cut. In one of the passages he, with great difficulty, discovered, through a narrow aperture, a small octagonal room, remarkable for the elegance of its form. Tournefort speaks of two small chambers, almost round (*presque rondes*), cut in the rock, at what he considered the most distant or innermost part of the labyrinth. On

the walls of these rooms he found several names of visiters, which had been written with charcoal during the time that the Venetians were masters of Candia. He copied two or three of these; for example:—"Qui fu el strenuo Signor Zan de Como, Cap^no. dela Fanteria, 1526." (Here was the bold Signor Zan de Como, a captain of infantry.) "P. Francesco Maria Pesaro, Capucino (a Capuchin friar); Frater Taddeus Nicolaus (another friar), 1539." In these rooms, and in the passages leading to them, were several other dates (written or cut out by the chisel), ranging from the year 1495 to 1579, and Tournefort added 1700, the year of his visit. According to this correct old traveller, the most tortuous and difficult part of the labyrinth is that which branches off to the left, at about thirty paces from the entrance, where an infinitude of passages, some crossing each other, and some having no outlet, perfectly bewilder the explorer. Sandys, who visited the island of Candia more than two centuries ago, but whose curiosity did not lead him to the labyrinth, tells us, that he "had heard an English merchant (who hath seen it) say, that it was so intricate and vast, that a guide which used to show it unto others for twenty years together lost himself therein, and was never more heard of." There is no water dripping through the rocks, no congelation of any kind, but, throughout, the labyrinth is dry, and the air of an equal and pleasant temperature.

According to the early part of Grecian history or tradition, where fable is mingled with fact, or nearly everything is to be taken in an allegorical sense, the key to which we have lost, the labyrinth was made, in imitation of a similar work in Egypt, by Dædalus the Athenian, for the second Minos, King of Crete, who flourished some thirteen centuries before the Christian era. The story of the monstrous Minotaur that ranged through these recesses, and of Theseus who was shut up in them to be devoured, and of the fair Ariadne who extricated her lover by giving him a clue of thread, belongs to the most imaginative part of mythology, and will hardly assist us in conjecturing what the place was really intended for. It has been called a catacomb, but no remains of any kind, indicating that it was put to such a use, have ever been found in it or about it. "The labyrinth," says Mr. North Douglas, "could never have been intended for a burial place, as we find none of those recesses in the walls which were used as sepulchres in the catacombs of Italy and Malta, nor indeed any other place fitted for the reception of a corpse." Belon and other old travellers concluded it was merely a stone quarry. Sandys says, "but by most this is thought to have been but a quarry where they had the stone that built both Cnossus and Gortyna; being forced to leave such walls for the support of the roof, and by following of the veins, to make it so intricate."

A modern traveller, Monsieur Sonnini, who, however, like Sandys, never visited the labyrinth, adopts this opinion, and unnecessarily refers the quarry to a much more modern date. Mr. North Douglas who, Theseus-like, explored the passage with a clue of thread in 1812, objects to these conclusions. He says, "Independently of there being no city nearer to it than Gortyna, which in comparatively modern times could never have required so large a quantity of materials, is it likely that there would have been such extreme regularity of design, such handsome chambers and entrances, and above all, such artful intricacy, so evidently intended to mislead, if the object had been a mere stone quarry? The traditions of the country-people, among whom it still bears the name of Ο Λαβυρινθος, (the labyrinth) seem to confirm its antiquity; but its precise object, though it clearly enough appears to have been intended, generally, for purposes of concealment, must yet remain a matter of doubt."

Tournefort had already rejected as an absurdity the idea of the place being a quarry. He says the stone has nothing peculiar to recommend it—that precisely the same material is found in the hill directly above Gortyna, and close to Cnossus. Was it then probable that people would seek at a distance across rude mountains and deep valleys for what they had close at hand? Would they make a choice of all kinds of difficulties, rather than cut the stone on the spot they wanted it, and where there were no difficulties at all? After a good deal more to the same purpose, Tournefort concluded that the labyrinth was originally the work of nature,—a *lusus naturæ*, but that man, whose handiwork is everywhere visible in it, had taken delight, or had found some advantage in enlarging it where it was narrow, and in giving regularity to its sides, roof, &c. "The ancient Cretans," he continues, "a people highly civilized and much attached to the fine arts, were disposed to finish what nature had only sketched out. Without doubt some shepherds having discovered these subterranean passages, gave room to greater men to make out of them this marvellous labyrinth, which might serve as an asylum to many families, during civil wars or the reigns of tyrants, although they now only serve as a retreat to the bats." He might have added that in ages when robbery and violence were held to be heroic virtues, and the seas of Crete swarmed in an especial manner with pirates, the people flying from the coast at times would be happy to have so excellent a hiding-place for themselves and their goods.

He conjectures that the ancient Cretans did not touch that part of the passage where it is necessary to crawl on hands and knees, because they wished posterity should know, by seeing it, how all the rest was made originally by nature, and how much their art and industry had done to improve it. Beyond that narrow passage the labyrinth is as regular and beautiful as it is before reaching that point. In support of Tournefort's hypothesis it should be mentioned, that many natural grottoes and long caverns exist in this volcanic island, and that Mount Ida, close by, is in many places quite honey-combed with them.

We will offer no conjecture of our own, but leave that pleasant field open to our readers. One thing is certain, that whether it be the labyrinth so often referred to by ancient writers (and we are inclined to think it is) or whether it be wholly, or only in part, the work of man, the labyrinth visited and described by Tournefort and Mr. North Douglas, is an exceedingly curious and interesting place.

The latter gentleman was of opinion that the primitive meaning of "labyrinth," which he thought was a word of Phœnician origin, might assist us in discovering something of its history and uses.

CAPACITY OF THE CHEST, AND ITS CONDITION DURING BODILY EXERTION

(From Sir C. Bell's Dissertations in the new edition of 'Paley's Natural Theology.')

Suppose a machine formed of two boards of equal diameter, and joined together by leather nailed to their margins like a pair of bellows: a hole is made in the upper board into which is inserted a tube. Now if a person mount upon this apparatus when it is filled with water, and blow into the tube, he can raise the upper board, carrying himself upwards by the force of his own breath—indeed by the power of his cheeks alone. It is on the same principle that, when a forcing pump is

let into a closed reservoir of water, it produces surprising effects. The piston of the hydraulic press being loaded with a weight of one pound, the same degree of pressure will be transmitted to every part of the surface of the reservoir that is given to the bottom of the tube, and the power of raising the upper lid will be multiplied in the proportion that its surface is larger than the diameter of the tube. Or, to state it conversely: suppose we had to raise the column of water in the tube by compressing the reservoir, it would require the weight of a pound on every portion of the superficies of the reservoir equal in extent to the base of the piston, before the water could be raised in the tube. If the apparatus which we have described were full of air instead of water, we should witness a similar effect; for all fluids, whether elastic or not, press equally in all directions; and this is the law on which the phenomenon depends. If we blow into the nozzle of a common pair of bellows, it is surprising what a weight of books we can heave up if laid upon its board.

Understanding, then, that the power of the hydraulic press, in raising the lid, depends on the size of the reservoir, and its relation to the tube; and again, that in pressing the fluid up through the tube, the pressure upon the sides of the reservoir must be the greater the larger the cavity, we can conceive how a glass-blower propels the air into his blow-pipe with great ease, if he blows with the contraction of the cheeks, the smaller cavity; but with an exhausting effort, if he blows by the compression of the larger cavity, the chest. Dr. Young made a calculation, the result of which was, that in propelling the air through a tube of the same calibre, a weight of four pounds operating upon a cavity of the size of the mouth would be equal to the weight of seventy pounds pressing upon a cavity of the dimensions of the chest*.

* The action of one who uses the blow-pipe is rather curious. The mouth is distended with air, and the passage at the back of the mouth closed; the man breathes through the nostrils, but from time to time admits a portion of air into the mouth in expiration. The pressure into the blow-pipe is from the distension and consequent elasticity of the cheeks, occasionally assisted by the buccinator muscle, or trumpeter's muscle, so called because it compresses the distended cheeks. In this way the stream of air through the blow-pipe is kept up uninterruptedly, whilst the man breathes freely through his nostrils.

Let us see how beautifully this hydraulic principle is introduced to give strength in the common actions of the body. We have remarked that the extension of the superficies of the thorax is necessary to the powerful action of the muscles which lie upon it; and these are the muscles of the arms. We must all have observed, too, that in preparation for a great effort, we draw the breath and expand the chest. The start into exertion and of surprise, in man and animals, is this instinctive act. But unless there were some other means of preserving the lungs distended, the action of those muscles which should be thrown upon the arms, would be wasted in keeping the chest expanded. It is here, then, that the principle which we have noticed is brought into play. The chink of the glottis, which the reader has already understood to be the top of that tube which descends into the lungs, is closed by a muscle not weighing a thousandth part of the muscles which clothe the chest; and this little muscle controls them all. A sailor leaning his breast over a yard-arm, and exerting every muscle on the rigging, gives a direction to the whole muscular system, and applies the muscles of respiration to the motions of the trunk and arms, through the influence of this small muscle, that is not capable of raising a thousandth part of the weight of his body; because this little muscle operates upon the chink of the glottis, and is capable of opposing the whole combined power of all the muscles of expiration. It closes the tube just in the same way that the man standing on the hydraulic bellows can with his lips support his whole weight. Thus it is that the muscles which would else be engaged in dilating the chest are permitted to give their power to the motions of the arms.

Some cruel experiments have been made, and for whatever intended, they illustrate the necessity of closing the top of the windpipe during exertion. The windpipe of a dog was opened, which produced no defect until the animal was solicited by his master to leap across a ditch, when it fell into the water in the act of leaping; because the muscles which should have given force to the fore-legs lost their power by the sudden sinking of the chest. The experiment is sufficiently repugnant to our feelings; and I need not offend the reader by giving instances in further illustration from what sometimes takes place in man.

*** The Office of the Society for the Diffusion of Useful Knowledge is at 59, Lincoln's Inn Fields.

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